

## Claims

1. A method for determining luminescent molecules by means of optical excitation in confocal measuring  
5 volumes, in particular the method of fluorescence correlation spectroscopy (FCS), comprising the steps of:
- a) providing a sample (12) comprising luminescent molecules,
  - 10 b) irradiating the sample (12) with an optical excitation device (2, 4, 6, 8) comprising at least one irradiation device for producing multiple beams and a focusing optics (8) for focusing  
15 penetrating multiple light beams into multiple confocal volume elements,
  - c) capturing emitted radiation from the multiple confocal volume elements by means of a spatially resolving sensor matrix arrangement (20), the  
20 sensor matrix arrangement being a sensor matrix of avalanche photodiodes AD that is produced using IC technology, in particular CMOS technology, and is integrated in a sensor chip (20) with Geiger mode wiring, and
  - 25 d) processing the signals provided by the avalanche photodiode matrix by means of a signal processing and evaluation device that is preferably integrated in the sensor chip.
2. The method as claimed in claim 1, characterized in  
30 that an irradiation device having at least one light source and at least one, in particular diffractive, optical element is used for splitting penetrating light into multiple beams.
- 35 3. The method as claimed in claim 1 for carrying out fluorescence correlation spectroscopic examinations on luminescent molecules, the signal processing comprising the steps of autocorrelation or/and cross-correlation

or/and fast Fourier transform (FFT) of measuring signals or information derived therefrom.

4. The method as claimed in claim 3, in which  
5 correlation steps of various correlation orders are carried out for signal evaluation.

5. The method as claimed in claim 3 or 4, in which  
the signal processing comprises correlation steps using  
10 the one-bit method or/and correlation steps using the 4x4-bit method.

6. The method as claimed in one of the preceding  
claims, in which the signal processing comprises  
15 correlation steps using the multi- $\tau$  method.

7. A device for determining luminescent molecules by  
means of optical excitation in confocal measuring  
volumes, in particular for carrying out the method as  
20 claimed in one of the preceding claims,  
comprising:

- a) a carrier arrangement (9) for holding a sample (12) that contains molecules to be determined,
- b) an optical excitation device (2, 4, 6, 8) for  
25 providing multiple light beams and, in particular,  
comprising at least one light source (2), at least one passive or active diffractive optical element (7) for splitting penetrating light into multiple beams, and a focusing optics (8) for focusing  
30 penetrating multiple light beams into multiple confocal volume elements in the respective measuring volume for the purpose of exciting luminescence in the multiple confocal volume elements,
- 35 c) an optical detection device (20) for detecting luminescence from the confocal volume elements, the optical detection device comprising a spatially resolving sensor matrix of avalanche

- photodiodes AD that is produced using IC technology, in particular CMOS technology, and is integrated in a sensor chip (20) with Geiger mode wiring, for capturing emitted radiation from the multiple confocal volume elements, and
- 5 d) signal processing and evaluation means for processing the signals provided by the avalanche photodiode matrix (20).
- 10 8. The device for determining luminescent molecules as claimed in claim 7, in which the signal processing and evaluation means are integrated in the sensor chip (20).
- 15 9. The device for determining luminescent molecules as claimed in claim 7 or 8, in which the signal processing and evaluation means comprise at least one correlator, preferably a number of correlators, for carrying out signal correlation operations, in
- 20 particular for determining autocorrelation functions or/and cross-correlation functions of first or/and higher correlation orders of measuring signals.
- 25 10. The device for determining luminescent molecules as claimed in one of claims 7 - 9, in which the signal processing and evaluation means comprise circuits for carrying out a fast Fourier transform of the measuring signals.